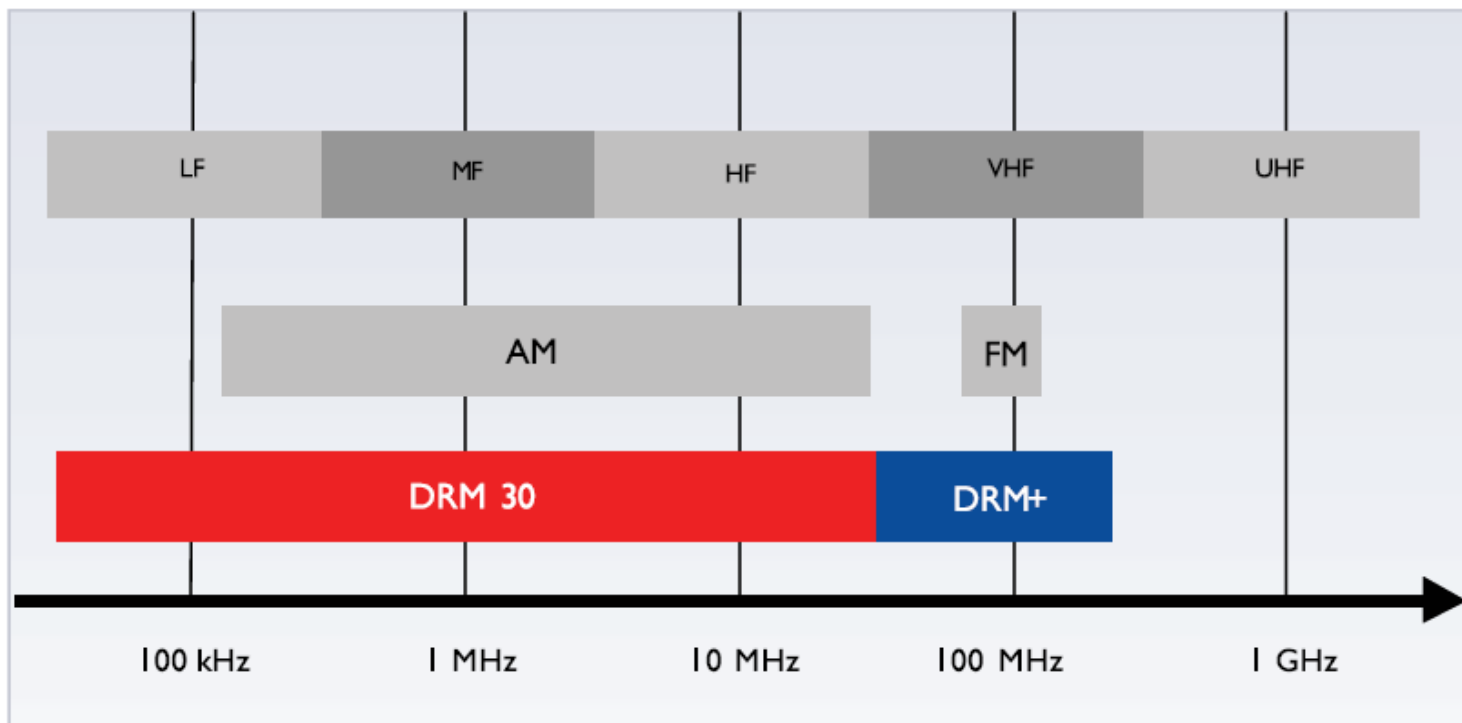




DRM frequency band overview. (Courtesy of the DRM.org)

DRM – Digital Radio Mondiale: Spectrum within a Spectrum

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It is rather puzzling when one thinks why a reliable method for digital transmission at low frequencies has not yet been of wide use. Actually, such a method has existed for some years now. It was formed under the name of DRM, (Digital Radio Mondiale), mondiale means worldwide, at Guangzhou, China, back in 1998. It was started as a non-profit international organization whose aim was digitize what had been until then only analog broadcasting. It sought to bring several digital schemes to all areas of the spectrum from the LF up to VHF-III bands.

The first system for DRM broadcasting below 30MHz was named DRM30. The evolution of it is called DRM+ and expands spectrum usage from 30MHz up to VHF Band-III, centered on the well-known FM band. The DRM spectrum's coverage layout may be seen in the picture above.

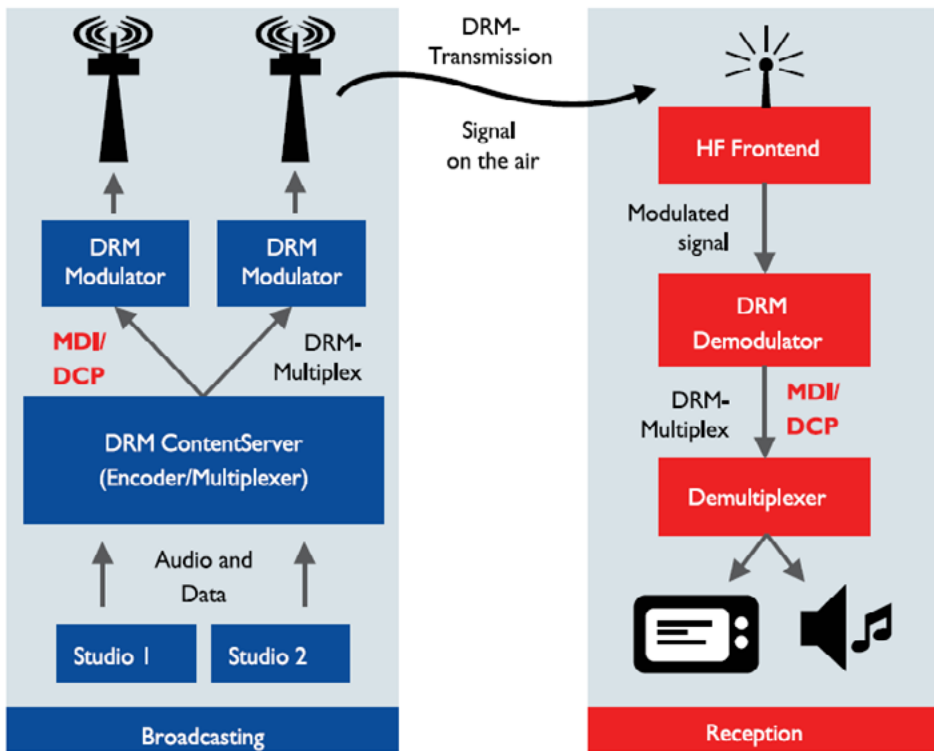
DRM is an active international committee under the International Telecommunications Union (ITU) and over the years, the technology has gained momentum as more countries and worldwide broadcasters join this very promising broadcasting technology.

By design, DRM coexists peacefully on the air with analog transmissions in the AM, HF, and FM spectrum and highlights the pathway to a full digitization of all bands. Broadcasters, through various international agreements, have had plenty of time to settle on the worldwide specifications

for the full utilization of this technology. While most of the DRM's core functionality has already been settled and is being enjoyed by listeners around the world, DRM receivers are still not so widely available in the Western world, but India and many other countries in the Far East have already adopted DRM as the broadcasting and radio listening method of choice.

DRM utilization of the spectrum is open in the sense that both DRM broadcasters and manufacturers of DRM receivers can freely implement automation and information services along with any well designed multimedia and/or text service. And all these services become available to any listener who tunes in the delivering frequency using a DRM enabled radio receiver.

DRM's spectrum usage starts at 150 kHz and, as frequency goes up, channels may host up to four distinct digital services for voice, music and/or data content. The fundamental advantages of DRM are its ability to deliver sound of exceptional quality, never heard before on AM, HF, FM and VHF bands, along with data content that compliments the audio experience. It offers a mix of other information services, such as emergency weather notifications, through any portable or car radios with DRM enabled receivers. A special service, known as Journaline, a trademarked data application for DAB and DRM digital radio systems. The following pic-



Modulating the DRM signal. (Courtesy of DRM.org)

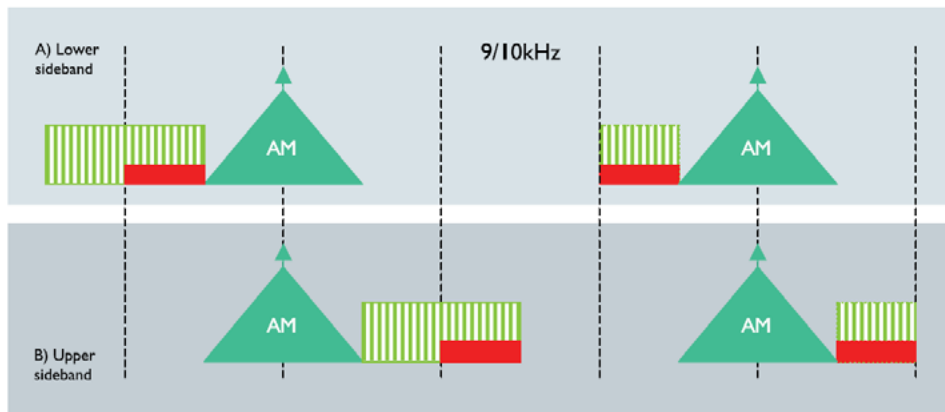
ture (above) displays the implementation of the DRM broadcasting system.

The prime mechanism by which all this content comes together and goes into the spectrum's air is based on an intelligently designed content multiplexer-server, called the DRM Content Server. A Configuration Interface Unit, part of this server, according to programmable or predefined broadcasting templates and schemata, multiplexes audio, data and other useful content such as GPS info and streams it as frames through an OFDM modulator to the air.

During this transition period, as we move from purely analog transmissions to the DRM spectrum space, broadcasters may simultaneously broadcast analogue and DRM content using the same transmitter and antenna systems. This is made possible by a method called Simulcast. For DRM30 and, in one of the various implementations of simulcast, the same program at the 9/10 kHz channel is broadcast as a 4.5/5 kHz USB DRM digital signal and as a 4.5/5 LSB analog signal that can be demodulated by conventional AM receivers and DRM enabled receivers. Adjacent channels in Simulcast are depicted as the graphic found below.

DRM bandwidths at the different spectrum bands are 4.5 kHz, 5 kHz, 9 kHz, 10 kHz, 18 kHz and 20 kHz for DRM30 and 100 kHz for DRM+. The

Simulcasting analog and DRM programming. (Courtesy of the DRM.org)



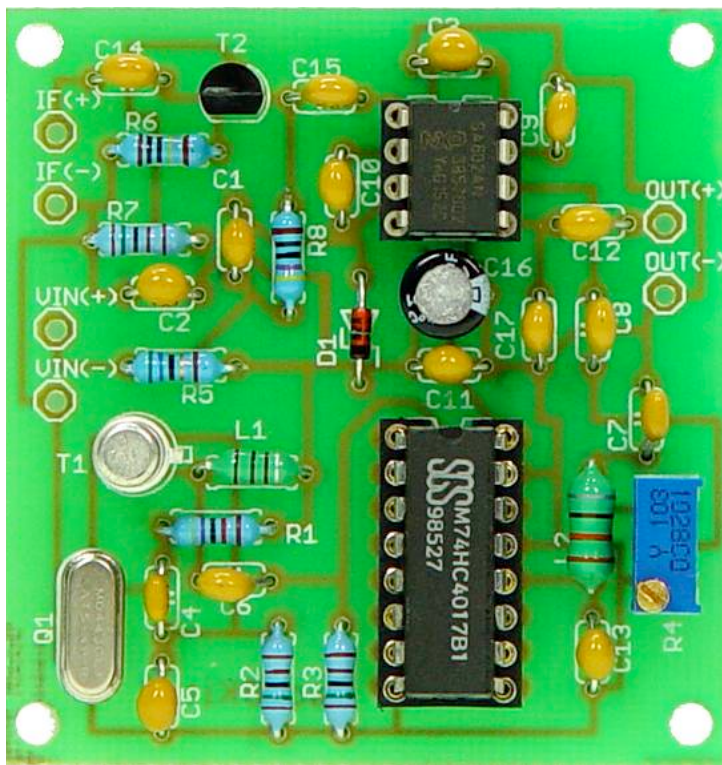
modulation method for DRM broadcasting is COFDM and each separate carrier, with a maximum of four, is QAM modulated. Lots more technical details can be found at <http://www.drm.org>.

Some manufacturers of analog radio receivers already deliver units that are either 100% DRM based or are enabled for both analog and DRM reception. Switching between the two occurs via a selection interface. Some other manufacturers, such as ETON or TECSUN, offer quality analogue radio receivers with a secondary AM IF output at 455 kHz.

On my desk I have a TECSUN S-2000 radio (£253.58 or \$313.76), which performs exceptionally well on all receiving bands and also gives me that second IF output that I use to drive the following depicted IF demodulator unit named RadiOKit-2. This unit's output is fed on the input of my PC's sound card using an absolutely free SDR DRM software application named DREAM, which can be downloaded from <https://sourceforge.net/projects/drm>. I enjoy exceptional DRM audio quality from European DRM broadcast stations and also from others worldwide. RadiOKit-2 IF demodulator can be purchased for £26.75 (\$33.10) plus £7.15 (\$8.85) shipping at eBay UK at the following address, where detailed construction info can also be found, http://www.ebay.co.uk/sch/sis.html?_nkw=RADIOKIT+2+DRM+SSB+RADIO+BROADCASTS+DECODER+KIT+IF+-CONVERTER&_trksid=p2047675.m4100

The operation of this kit is that it simply converts the 455 kHz IF into the 12 kHz mixed audio content signal. Seems that a crystal operating at 443 kHz or 467 kHz, is needed so that the output can be mixed with the 455 kHz IF frequency of the receiver's output, to obtain the 12 kHz signal. But such a crystal does not exist.

Instead, the thing to do is use a common 4.433619 MHz crystal and via a 74HC4017 Johnson decade counter you'll get a division-by-ten output at 443.3(4) kHz frequency which is very close to the desired frequency. Since the crystal's circuitry output is a square pulse, it cannot be mixed directly with the IF. To overcome that, we use two capacitors and a ceramic coil, C13, C17, L1 in a low-pass Bessel



Radi0kit2 (Courtesy: http://www.ebay.co.uk/sch/sis.html?_nk-w=RADI0KIT+2+DRM+SSB+RADIO+BROADCASTS+DE-CODER+KIT+IF+CONVERTER&_trksid=p2047675.m4100)

filter configuration, the output of which is amplitude configurable via R4. This is the final LO frequency. The IF signal is passed through an N-JFET, BF245, so that it is buffered from the rest of the circuit via a 1 MOhm path, for the purpose of the protection of the stability of the reception's input. Both signals eventually are driven to the very "magic" and cute mixer IC, SA602AN, which delivers our 12 kHz mixed signal.

Any DC voltage source from 9 to 12 volts may be used. Special attention must be given to the quality and soldering of the coax between the IF output of the radio receiver and the IF input of our converter kit, because that path, if not well handled, may act as an input antenna to our converter kit.

With the aid of the SDR, Software Defined Radio DREAM software we can then demodulate and listen to any AM, DRM or SSB signal. We can even create and define our own DSP bandpass filters on DREAM for reception improvements. The SDR DREAM software gives numerous valuable options for us to configure both DSP and bandwidth adjustments as well as profiles testing. If other DRM30 or DRM+ spectrum bands demodulations are desired, where different IFs come into play, the above kit may be easily modified to meet the appropriate frequency ranges.

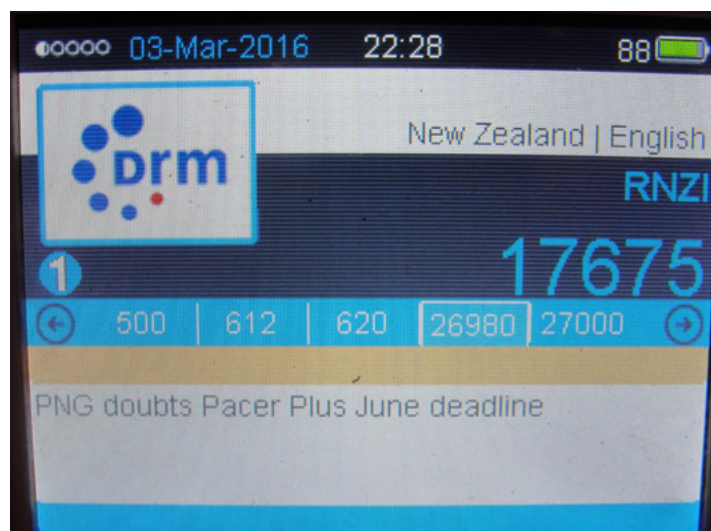
Many stations worldwide broadcast DRM content daily. Detailed and updated lists of all AM, HF, FM DRM stations and their frequencies as well as programs and times of broadcasting may be found at drm.org. There you will also find detailed literature for all the aspects of this technology and its current worldwide status as well.



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Avion AV-DR-1401 analog/DRM shortwave receiver, one of very few off-the-shelf DRM-capable radios. Made in India it is so far available only through Amazon.in. (Courtesy Avion)



Reception of Radio New Zealand International DRM broadcast on 17.675 MHz in US using an Avion AV-DR-1401 portable radio. Screen shows news text reception. (KS4ZR photo)

TSM